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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/065,956	12/04/2002	Bernhard Liegl	2001P19570US	2530
25962	7590	04/14/2004	EXAMINER	
SLATER & MATSIL, L.L.P. 17950 PRESTON RD, SUITE 1000 DALLAS, TX 75252-5793			SAGAR, KRIPA	
			ART UNIT	PAPER NUMBER
			1756	

DATE MAILED: 04/14/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/065,956	Applicant(s) LIEGL ET AL.	
	Examiner Kripa Sagar	Art Unit 1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 December 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 04 December 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>12/4/02</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Objections

1. Claim 15 is objected to because of the following informalities: The claim recites a pressure of 10 hPa. The notation is unconventional and *likely* a typographic error implying kPa. Confirmation or correction is required.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claim 1 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The claim recites a method of pattern transfer wherein the step of evaporating the solvent without using elevated temperatures reduces roughness on sidewall of a photosensitive layer after the development. The claim differs from Applicant admitted prior art solely in that respect. Instant specification states (p.2; I.4-5) that line-edge roughness (LER) is observed in "some types of resists" implying that it may be specific to the composition of the resists – which are not disclosed.

No particular compositions of photosensitive material are specified although ARCs and solvents are specified (p.3,#0011 & P.4;#0013). The solvents and the kinetics of drying differ significantly for each "type" or class of photosensitive material.

4. Claim 1 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification compares a conventional process containing no anti-reflection coating (ARC) with a current inventive process that contains an ARC. The Applicant ascribes the reduction in the LER (line edge roughness) to the inventive low temperature drying process – although it is well known in the art that ARCs reduce standing waves in the resist layer and thereby reduce LER. This is an art-recognized phenomenon and known to one of ordinary skill in the art. Applicant has not produced any evidence specifically correlating the reduction in LER with the drying process.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

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6. Claim 1 is rejected under 35 U.S.C. 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Japanese patent JP 64-015926 to Ofuji.

The claim recites a method of pattern transfer comprising lithographic steps wherein evaporating the solvent from the coated photosensitive layer without using elevated temperatures results in reduced sidewall roughness after exposure and development.

Ofuji teaches applying a resist on a substrate ("layer"); exposing the resist to a vacuum atmosphere at room temperature to evaporate the solvent. The resist is exposed to UV rays and the exposed areas are developed. Ofuji states that the low temperature curing prevents thermal decomposition of the photosensitive groups in the resist (Abstract).

Ofuji does not explicitly teach the reduction in sidewall roughness of patterns. However this is an inherent feature of the process as admitted by Applicant. Applicant states in the specification that the low temperature and/or vacuum curing prevents "phase separation" in the photosensitive layer. Improved line edges (sidewalls) are attributed to this (instant specification: p.2;#0006). Ofuji teaches the same principles. The improvement is an inherent consequence of Ofuji's process.

7. Claims 1,2,4-6,9,10,12,13,15,16,18 20,21 are rejected under 35 U.S.C. 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over US Pat.6261007 to Takamori et al.

Claim 1 teaches a pattern transfer method in fabricating an IC wherein the substrate coated with a photosensitive layer is dried without using elevated temperatures. The method results in a pattern with reduced sidewall roughness. Claims 20, 21 recite a photosensitive layer and a photoresist layer patterned by the said method using vacuum drying. Dependent claims 2,4-6,9,10,12,13,15,16, 18 recite, among others, using a photoresist, an ARC (anti-reflective coating), spin coating, vacuum, room temperature curing.

Takamori teaches that the steps of the instant invention recited in claim 1 are conventional in photolithography (col.1;line.19-48) which includes conventional drying or pre-bake at high temperatures. The process includes spin coating [cl. 4-6] of photoresist [cl.2]. Takamori improves on the process using low pressure drying at room temperature (2;49-46). Takamori teaches that this results in more uniform removal of solvents and hence reduced fluctuations in linewidths (2;24-29). Takamori does not explicitly teach reduction in LER; however this is an inherent consequence of the process. LER is known to contribute to fluctuations in linewidths and thus Takamori implicitly teaches the reduction in LER due to vacuum drying [cl.1,9,20,21]. The drying is accomplished at room temperature [cl. 10,13,16,18]. The pressure is reduced to 0.1 Torr (13.3Pa) which is within the range of the instant invention recited in cl. 12,15 (2;58-64).

Takamori does not teach use of elevated temperature drying. [cl.11,14,17,19]. However the kinetics of solvent evaporation from films are well known in the art (Takamori: 9;43-46). One of ordinary skill would readily know that solvents would

evaporate more rapidly under elevated temperature or reduced pressure; the vapor pressure and boiling point of the solvent dictating the combination of temperature and pressure. The instant temperatures and pressures can be readily arrived at by one of ordinary skill in the art.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 3,7,8 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat. 6443641 to Takamori et al. in view of US PG PUB 2002/0182514 to Montgomery et al.

The teachings of Takamori are recited above.

Takamori does not teach use of ARCs [cl.3,7,8].

Montgomery teaches the use of ARCs under photoresist coatings (fig.1A & p.3;#0019). The ARCs, well known in prior art, are routinely used to reduce standing waves in the resist, which are known to result in line edge roughness (p.3;#0020). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use ARCs under photoresists as known in prior art taught by Montgomery, because they are known to reduce standing waves and to minimize line edge roughness.

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Conclusion

10. Applicant has not established any correlation between solvent evaporation at low temperature and reduced LER as claimed. No evidence has been produced. Resist types are not disclosed. Diverse factors contribute to LER as shown below.

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US Pat.2003/0235775 to Padmanabhan et al. attributes LER to the photoactive compounds (PAC) in the resist (p.2;#0012).

US Pat. 662738 to Koh teaches that particle breakdown from resist walls during dry etching causes LER (2;21-30).

US Pat. 6405576 to Buffat teaches, that incomplete drying and residual solvent results in *sidewall angle* differential between nested and isolated patterns; but does not attribute any roughness (2;26-29).


Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kripa Sagar whose telephone number is 571-272-1392. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark F Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MH/ks



JOHN A. MCPHERSON
PRIMARY EXAMINER